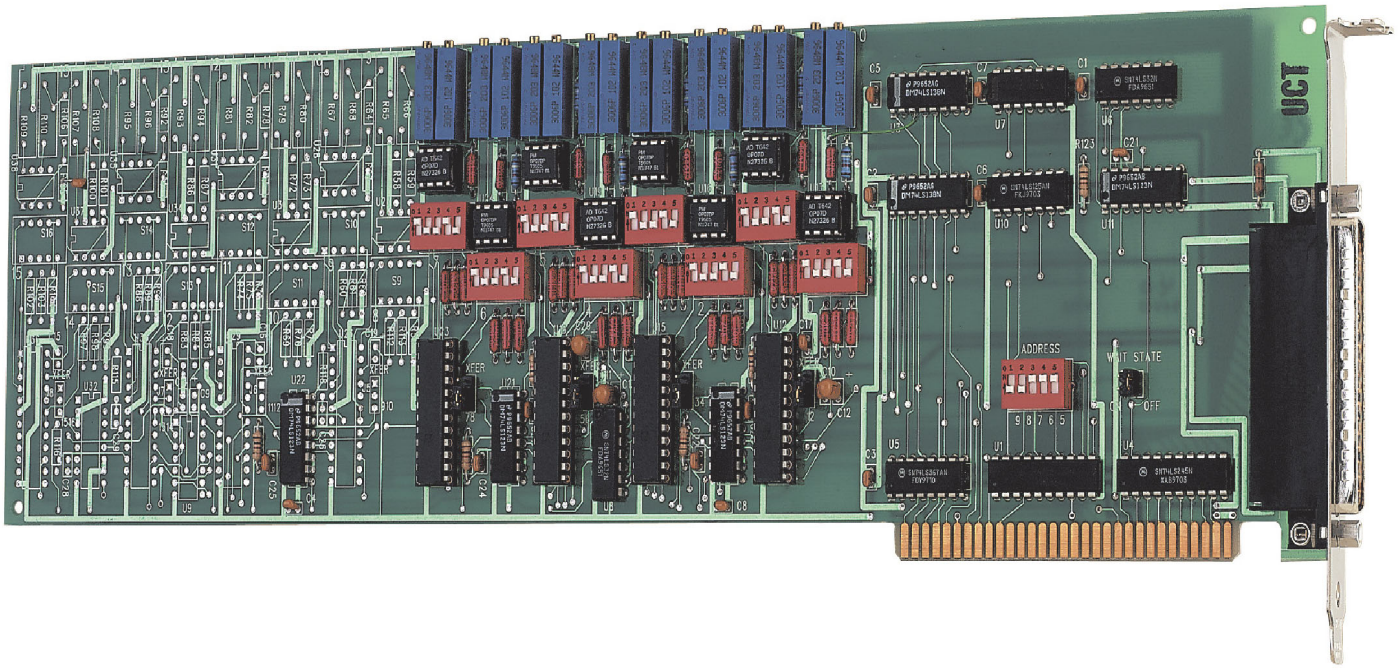
CIO-DAC08

Analog Output Board

User's Guide



MEASUREMENT COMPUTING™

CIO-DAC08

Analog Output Board

User's Guide

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the CIO-DAC08 board so that you get the most out of its analog output features. This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

The following conventions are used in this manual to convey special information:

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide information relevant to the operation of the CIO-DAC08.

- MCC's *Specifications: CIO-DAC08* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/CIO-DAC08.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

CIO-DAC08 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/CIO-DAC08.pdf.

Introducing the CIO-DAC08

Overview: CIO-DAC08 features

The CIO-DAC08 has 8 channels of 12-bit analog output (one D/A per channel). Analog outputs are dual-DAC AD7273s (two analog outputs per chip), with each output buffered by an OP07. The CIO-DAC08 is compatible with MetraByte's DDA-06 but lacks digital outputs. Software designed for the DDA-06 will operate the analog outputs.

Analog output ranges are switch-selectable for a Bipolar or Unipolar range. Bipolar ranges are ±10 V, ±5 V, and ±2.5 V. Unipolar ranges are 0 to 10 V, 0 to 5 V, and 0 to 2.5 V.

The analog outputs are controlled by writing a digital control word as two bytes to the DAC's control register. The control register is double buffered so the DAC's output is not updated until the second byte (the high byte) is written.

Each analog output pair is jumper-selectable for either individual or simultaneous update. When a DAC pair is set for simultaneous update, writing new digital values to the DAC's control register does not update the DAC's voltage output. Update of the output occurs only after a READ from the board's addresses.

The board also features a wait state generator that you enable with an on-board jumper.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DAC08, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version.

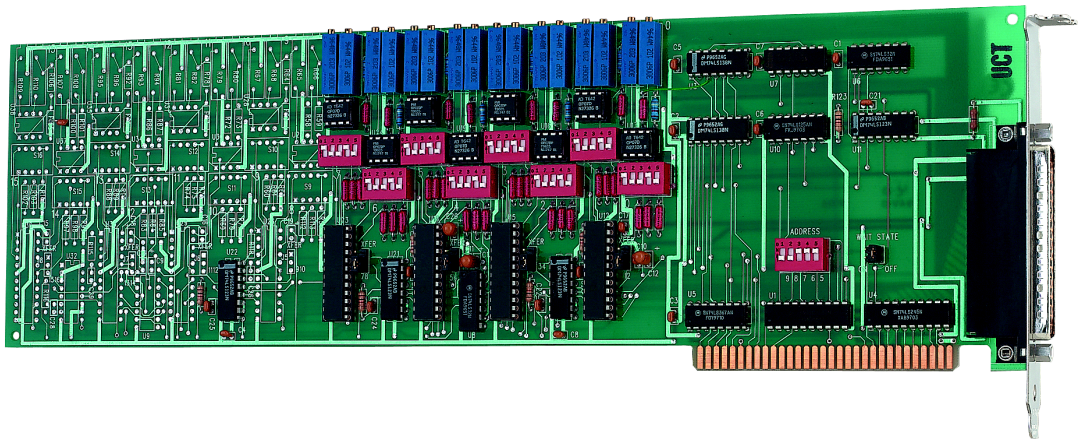
Installing the CIO-DAC08

What comes with your CIO-DAC08 shipment?

The following items are shipped with the CIO-DAC08.

Hardware

- CIO-DAC08



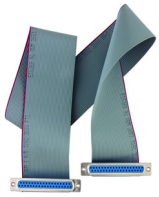
Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your CIO-DAC08 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

You can also order the following MCC products to use with your CIO-DAC08.

- Cables



C37FF-x

C37FFS-x

- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-DAC08. Refer to Field wiring, signal termination, and conditioning on page 14 for a complete list of compatible accessory products.

Unpacking the CIO-DAC08

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DAC08 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Configuring the CIO-DAC08

The CIO-DAC08 has one base address switch, one bank of gain switches for each analog output channel, a simultaneous update jumper for each DAC pair, a "power-up state" selection jumper, and one wait state jumper which you must set before installing the board in your computer. The *Insta*Cal calibration and test program included with the CIO-DAC08 will show you how to set the switches. Run *Insta*Cal before you open your computer and install the board.

The CIO-DAC08 is shipped with the factory-default settings listed below.

Factory-configured default settings

Board label	Switch/jumper description	Default setting
ADDRESS	DIP switch for setting the base address	300h (768 decimal)
WAIT STATE	Jumper to enable a wait state	OFF position
XFER	Jumper to select simultaneous or single channel update for each DAC channel pair	Single channel update
0 through **7**	DIP switches to set the analog output range	±5V
PWR UP	Jumper to select the power up and reset state	STD position — standard (undefined output values at power up)

Before installing the CIO-DAC08 in the computer, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the CIO-DAC08 board.

Base address switch

Before you install the CIO-DAC08 in your computer, set the base address by using the dip switch labeled **ADDRESS** located on the board.

The easiest way to set the base address switch is to let *Insta*CAL show you the correct settings. However, if are already familiar with setting ISA base addresses, you may use the base address switch description below to guide your base address selection.

Unless there is already another board in your system using address 300 hex (768 decimal), leave the switches as they are set at the factory. The example shown in Figure 1 shows the settings for the factory-default base address of 300 hex.

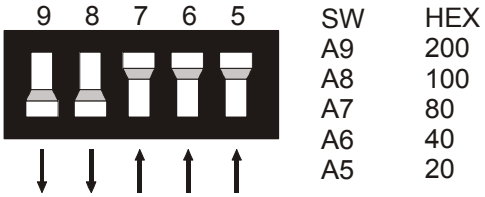


Figure 1. CIO-DAC08 base address switches

In the default configuration shown in Figure 1, addresses 9 and 8 are DOWN, and all others are UP. Address 9 = 200 hex (512 decimal) and address 8 = 100 hex (256 decimal); when added together they equal 300 hex (768 decimal).

Disregard the numbers printed on the switch

When setting the base address, refer to the numbers printed in white on the printed circuit board.

PC I/O addresses

Hex Range	Function	Hex Range	Function
000-00F	8237 DMA #1	2C0-2CF	EGA
020-021	8259 PIC#1	2D0-2DF	EGA
040-043	8253 Timer	2E0-2E7	GPIB (AT)
060-063	8255 PPI (XT)	2E8-2EF	Serial Port
060-064	8742 Controller (AT)	2F8-2FF	Serial Port
070-071	CMOS RAM & NMI mask (AT)	300-30F	Prototype card
080-08F	DMA page registers	310-31F	Prototype card
0A0-0A1	8259 PIC #2 (AT)	320-32F	Hard disk (XT)
0A0-0AF	NMI mask (XT)	378-37F	Parallel printer
0C0-0DF	8237 #2 (AT)	380-38F	SDLC
0F0-0FF	80287 numeric CO-P (AT)	3A0-3AF	SDLC
1F0-1FF	Hard disk (AT)	3B0-3BB	MDA
200-20F	Game control	3BC-3BB	Parallel printer
210-21F	Expansion unit (XT)	3C0-3CF	EGA
238-23B	Bus mouse	3D0-3DF	CGA
23C-23F	ALT bus mouse	3E8-3EF	Serial port
270-27F	Parallel printer	3F0-3F7	Floppy disk
2B0-2BF	EGA	3F8-3FF	Serial port

The CIO-DAC08 Base switch can be set for an address in the range of 000-3E0, so it should not be hard to find a free address area for your CIO-DAC08. If you are not using IBM prototyping cards, or some other board which occupies these addresses, then 300-31F HEX are free to use. Addresses not specifically listed, such as 390-39F, are free.

Wait state jumper

The CIO-DAC08 board has a wait state jumper which you can set to enable an on-board wait state generator. A wait state is an extra delay injected into the processor's clock via the bus. This delay slows down the processor when the processor addresses the CIO-DAC08 board so that signals from slow devices (chips) will be valid.

This jumper is shown in Figure 2 configured for OFF (wait state is disabled).

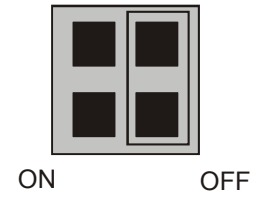


Figure 2. Wait State jumper

The wait state generator on the CIO-DAC08 is only active when the CIO-DAC08 is being accessed. Your PC will not be slowed down in general by using the wait state.

Individual / simultaneous update jumper

The analog output chips on the CIO-DAC08 are dual DACs (two analog outputs per chip). Each DAC channel pair has an associated jumper that sets both DACs on a single chip to be either simultaneously transferred on a read (XFER), or individually updated when the MSB register is written.

The top of each jumper on the CIO-DAC08 board is labeled **XFER**. Below each jumper are two numbers that indicate the pair of channels that the jumper selects (12, 34, 56, or 78). For example, "12" indicates channels one and two.

Figure 3 shows the jumper block configured for each update mode.

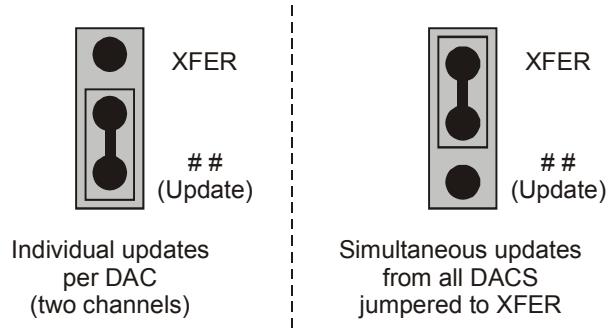


Figure 3. Individual / simultaneous update jumper

- When the jumpers are in the **XFER** position, new output data is held until one or more DACs have been loaded with new digital data. The new data transfers to the voltage outputs as a group. The simultaneous transfers occur when any of the CIO-DAC08 addresses are read (and the jumpers are in the **XFER** position).
- When jumpered to the channel numbers, the DAC channel pair is individually updated.

Power up and reset jumper

The power up and reset jumper (hardware revision 3 and later) controls the state of the DAC outputs when the CIO-DAC08 board is powered up or reset. This jumper is shown in Figure 4.

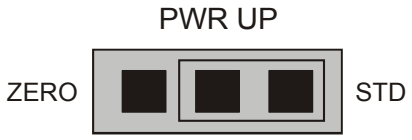


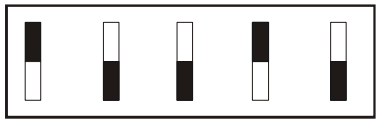
Figure 4. Power up and reset jumper

- When set for **ZERO**, all DACs are cleared to 0 volts, ±32 mV on power up and reset. In addition, all DACs are set to simultaneous update mode until first read.
- When set for **STD**, the analog output values are undefined on power up and reset.

Analog output range switch

The analog output voltage range of each channel can be set with a set of five ganged DIP switches. The switch blocks are located on the board below the calibration potentiometers. The switch blocks are labeled **0** to **7**, and individual switches are labeled **1** through **5**.

Set the switches for each individual channel as shown in Figure 5.



Range	1	2	3	4	5
±10	UP	DN	UP	DN	DN
±5.0	UP	DN	DN	UP	DN (shown)
±2.5	UP	DN	DN	DN	UP
0-10	DN	UP	UP	DN	DN
0-5	DN	UP	DN	UP	DN
0-2.5	DN	UP	DN	DN	UP

Figure 5. Analog output range switch—one per DAC — configured for ±5 V

To set a channel to a particular range, read the switch positions as UP or DN (down) from left to right in the row beside the range you want to set.

The switch shown in Figure 5 is configured for ±5V range (switch settings UP>DN>DN>UP>DN).

Installing the CIO-DAC08

After you configure the board's switches and jumpers, you can install the CIO-DAC08 into your computer. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available ISA slot.
2. Close your computer and turn it on.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	37-pin male D connector
Compatible cables	▪ C37FF-x ▪ C37FFS-x ▪ DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Pinout – main I/O connectors

The CIO-DAC08 I/O connector is a standard 37-pin male D connector that is accessible through the PC/AT expansion bracket.

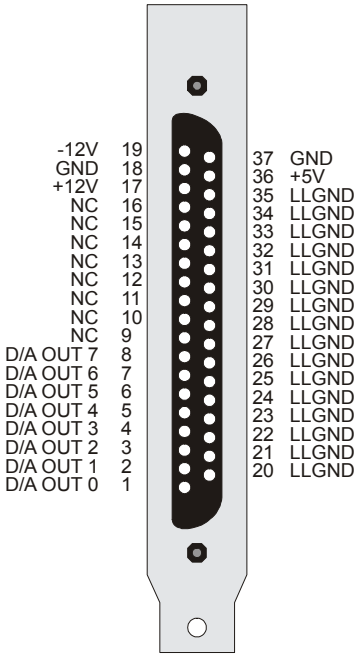


Figure 6. I/O connector pin-out

The analog outputs of the CIO-DAC08 are two-wire hook-ups. Always use low-level ground (LLGND) as the ground reference for all analog hook-ups.

Cabling

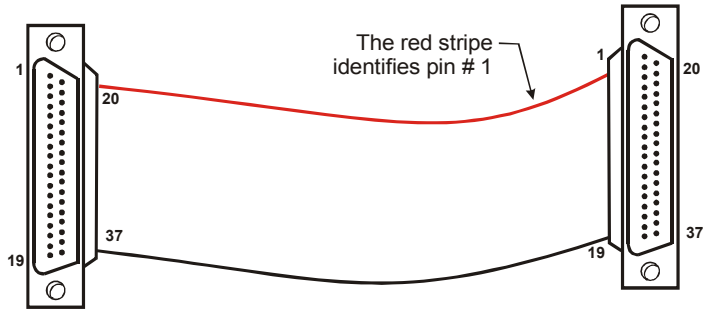


Figure 7. C37FF-*x* cable

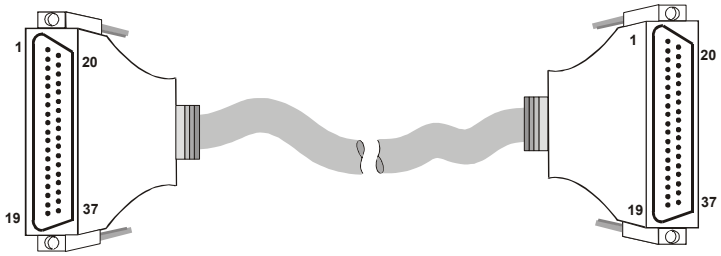


Figure 8. C37FFS-*x* cable

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the CIO-DAC08.

- CIO-MINI37 – 37-pin screw terminal board. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=255.
- CIO-TERMINAL – 37-pin screw terminal board with on-board prototyping area. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=282.
- DFCON37 – Connector kit that includes a 37-pin female D-connector, D-shell, 37 crimp pins, and cable termination kit to construct your own cable. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=103&pf_id=304.

Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use. In general there may be no correspondence among registers for different boards. Software written at the register level for other models will not function correctly with your board.

Programming languages

Measurement Computing's Universal Library provides access to board functions from a variety of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, please refer to the *Universal Library User's Guide* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs now have drivers for your board. If the package you own does not have drivers for your board, please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us by phone, fax or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-DAC08 and CIO-DAC16*. This document is available on our website at www.mccdaq.com/registermaps/RegMapCIO-DAC08_16.pdf.

Functional Details

Signal connections

Each of the CIO-DAC08 outputs are individually buffered through an OP07 operational amplifier (OP-AMP). The OP07s are socketed so that if one fails it can be replaced in the field. The OP07 for each channel is located just below the calibration potentiometers for that channel.

At the full rated output swing of ±10V, each channel is capable of sinking or sourcing ±5 mA. That means a load of 2K Ohms can be connected to each channel.

As the load resistance is raised from 2 K up to 10 MΩ or more, the output load on the DAC decreases. Any load resistance greater than 2K is fine.

As the load resistance decreases, the output load increases. The OP07 responds by producing a lower output voltage. If your CIO-DAC08 will not produce the output voltage specified by the code & range combination, it is a good idea to check the load with an ohm meter.

Under normal circumstances you will not damage the OP07 by connecting the output to ground. If your connection results in a failure of the OP07, chances are good that there was some potential at the connecting point in addition to a load at ground or between 0 and 2 K Ω. Explore the point with a DVM before reconnecting the CIO-DAC08 (and after replacing the OP07 of course). Connect the negative lead of the DVM to any LLGND pin of the CIO-DAC08.

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

Analog output

Table 1. Analog input specifications

Parameter	Conditions	Specification
D/A converter		AD7237
Resolution		12-bits
Number of channels		*8 voltage outputs*
Output ranges		±10 V, ±5 V, ±2.5 V, 0 to 10 V, 0 to 5 V, 0 to 2.5 V. Each channel independently switch selectable.
D/A pacing		Software paced
Data transfer		Software
Offset error		Adjustable to zero
Gain error		Adjustable to zero
Differential nonlinearity		*±½ LSB max*
Integral nonlinearity		*±½ LSB max*
Monotonicity		12-bits
Gain drift (DAC)		*±30 ppm/°C max*
Offset drift (DAC)		±3 ppm/°C max
Throughput		System dependant
Slew rate		0.3 V/µS typical
Settling time	*20 V step to .01%*	*70 µs*
Current drive		*±5 mA min*
Output short-circuit duration		*Indefinite*
Output coupling		*DC*
Output resistance (OP-07)		*0.1 ohm max*
Miscellaneous		▪ Double buffered output latches ▪ Update DACs individually or simultaneously (jumper selectable by pairs) ▪ Power up and reset option, jumper selectable (revision 3 and later): With jumper set to "ZERO", all DACs are cleared to 0 volts, ±32 mV, and DACs are set to simultaneous update mode until first read. With jumper set to "STD", DAC output on power-up is undefined.

Power consumption

Table 2. Power consumption specifications

Parameter	Conditions	Specification
Supply current	+5 V supply	435 mA typical, 525 mA max
	+12 V supply	75 mA typical, 98 mA max
	-12 V supply	52 mA typical, 68 mA max

Environmental

Table 3. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 100 °C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 4. Connector specifications

Connector type	37-pin male "D" connector
Compatible cables	C37FF-x C37FFS-x DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL

Table 5. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	D/A OUT 0	20	LLGND
2	D/A OUT 1	21	LLGND
3	D/A OUT 2	22	LLGND
4	D/A OUT 3	23	LLGND
5	D/A OUT 4	24	LLGND
6	D/A OUT 5	25	LLGND
7	D/A OUT 6	26	LLGND
8	D/A OUT 7	27	LLGND
9	NC	28	LLGND
10	NC	29	LLGND
11	NC	30	LLGND
12	NC	31	LLGND
13	NC	32	LLGND
14	NC	33	LLGND
15	NC	34	LLGND
16	NC	35	LLGND
17	+12V	36	+5V
18	GND	37	GND
19	+12V		

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Category: Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

CIO-DAC08

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN55022 (1987), EN50082-1

Emissions: Group 1, Class B

- EN55022 (1987): Radiated and Conducted emissions.

Immunity: EN50082-1

- IEC 801-2 (1987): Electrostatic Discharge immunity, Criteria B.
- IEC 801-3 (1984): Radiated Electromagnetic Field immunity Criteria A.
- IEC 801-4 (1988): Electric Fast Transient Burst immunity Criteria B.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in December, 1995. Test records are outlined in Chomerics Test Report #EMI0168B.95.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

Carl Haapaoja, Director of Quality Assurance

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